

Writing an abstract

An abstract is a brief overview of your entire research. It should be written when your research is complete and can serve as an explanation and justification of your time spent at the lab. The abstract briefly states the research problem or purpose of the research (Introduction), how the problem was studied (Methods), what was discovered (Results), and how the results might be interpreted (Discussion and Conclusions). Acronyms or abbreviations may be used; however, they should be spelled out the first time used and not used in the title. To introduce acronyms or abbreviations, use the full name followed by the acronym used in parenthesis (i.e. Department of Energy (DOE).)

The abstract should serve as a "stand alone" document because it may be the only part of the research some reviewers read (this is true of almost all science publications). DO NOT refer to sections in the research paper or citations. An abstract should present information in the order in which it will appear within the research paper. Consequently, it should be revised until it is an accurate summary of the entire project.

What are the style constraints for the project abstracts?

- Your name and your DOE mentor's name should be IN ALL CAPITAL LETTERS.
- Your abstract should be a single paragraph and should be concise.
- Length is limited to a maximum of 2500 characters including spaces.
- Jargon or acronyms must be spelled out or defined the first time each is used.
- An abstract should stand on its own, and not refer to something in the body of the paper, such as a figure, table or portions of the paper.
- Results are the focus of an abstract. Limit background information to a sentence or two.
- YOUR contributions, YOUR tasks, and YOUR analysis are the focus.
- What you report in an abstract must be consistent with what you report in the paper.
- Correct spelling, clarity of sentences and phrases, and proper reporting of quantities (proper units, significant figures) are just as important in an abstract as anywhere else.
- Verb tense is important. To summarize work completed, use past tense. To present facts, use present tense.
- Language should be formal, meaning 3rd person, no contractions and no colloquialisms. In other words, instead of saying "we did this," say "this was done."
- Bibliography or citations are not included in the abstract.

What do you include when writing research project abstracts?

1. Project title, Research Category, Program, Site, Term. Title should be descriptive not creative.

2. Introduction of your project/ experiment

- Start with an introductory statement of the reason for investigating the project topic.
- Identify the goals and objectives of the research.
- Include a statement of the problem or hypothesis being studied.
- Include any possible or current research applications.

3. Methods Used

- Summarize the key points.
- Give an overview of the investigation you conducted.
- Include procedures only you, the student, did.
- Do not include your mentor's work (such as surgical procedures), work done by a university lab, or work done prior to your involvement in your project (unless comparing these to your advancements is important), in which case acknowledge the work done by others, but focus on your own contribution to the research.
- Do not include acknowledgments.
- Do not give excessive details about the materials used unless it greatly influenced the procedure or had to be developed to perform the investigation. Procedure names are important and should be included.

4. Observation/Data/Results

- State key results leading directly to your conclusions.
- Include statistical if you have them.
- Do not give too many details about the results nor include tables or graphs. (ex. lists of numerical data)
- If you were unable to obtain any results, explain why.

5. Conclusions

- Interpret results as they relate to the problem and/or compare findings with other existing research.
- State briefly conclusions that you derived from your investigation.
- Reflect on the process and possibly state some applications and extensions of the investigation.
- Make sure you summarize the meaning or importance of your work.

What is different when writing *alternative* project abstracts?

1. Project title, Research Category, Program, Site, Term and Introduction are the same as research project abstracts, but identify your type as “alternative.”

2. Methods are replaced by Reference Material Summary in order to:

- Identify resources that are used to create the project/policy/application.
- Summarize briefly existing policy, model or program.
- Identify key considerations of design.

3. Results are replaced by Comparison or Interpretation in order to:

- State where in the development you ended your project, compared to the purpose of the project.
- Include results of the testing, implementation or statistics, if you have them.
- Compare the new policy or application to the old one.

4. Conclusions are replaced by Discussion in order to:

- Define the relevance or value of YOUR policy, procedure or design.
- Suggest further testing or work that still needs to be done.
- Suggest applications of the program, policy or model.

HELPFUL HINTS:

- DO keep it concise by wording sentences so they serve MORE THAN ONE PURPOSE. (For example, you could write the introduction, background and purpose in one sentence.)
- DO strive for WORD ECONOMY.
- DO have your mentor READ this at least TWICE: once after you have revised it and once after you have incorporated suggestions, but before you post it online.
- DO SPELL CHECK AND read it out loud to make sure it READS WELL.
- DO have a friend who is doing different research read it. This way you will AVOID JARGON that you and your mentor might miss because the two of you are too familiar with the project.
- DO read several abstracts from a journal in your field or from previous editions of the Journal of Undergraduate Science.
- DO review the RUBRIC and follow the criteria.
- DO ASK FOR HELP if you are having trouble.
- Since there is no colon after DO, there shouldn't be one after DO NOT in the following bullets.
- DO remember that you are submitting to a general purpose journal and background may be required to adequately introduce your research.
- DO NOT wait until the last minute.
- DO NOT assume that this is unimportant.
- DO NOT sacrifice content or readability for brevity.
- DO NOT string together a bunch of jargon just to sound cool. If it does not sound good to your readers, it is not useful.
- DO NOT refer to a section, footnote, graph or table, in the body of the paper.
- DO NOT say in multiple sentences what you can say in one.
- DO NOT use undefined acronyms.

<u>Grading Rubric for Research Abstract</u>	<u>2</u> Fully meets all requirements and expectations	<u>1</u> Partially meets requirements	<u>0</u> Does not meet minimum requirements
Mechanics. The abstract contains proper spelling, grammar, complete sentences, syntax, diction, and is readable.	<ul style="list-style-type: none"> Contains no spelling, word usage, grammar, or mechanics mistakes. Defines all acronyms and abbreviations except the <i>very</i> common ones. 	<ul style="list-style-type: none"> Contains two or fewer mistakes in grammar, word usage, spelling, or mechanics. Contains one or more undefined acronym or abbreviation or key terms. 	<ul style="list-style-type: none"> Contains three or more mistakes Contains numerous undefined terms.
Introduction. The abstract briefly states the subject of investigation purpose of project and its context.	<ul style="list-style-type: none"> Gives concise, thorough introduction to provide context and background of project. Includes statement of the problem being studied. 	<ul style="list-style-type: none"> Either fails to define key terms or to uses them correctly. Either fails to give enough information or to provides unclear context or background. 	<ul style="list-style-type: none"> Contains no introduction. Starts with either methods or results.
Methods. The abstract identifies how the problem was studied and defines all jargon, abbreviations or acronyms.	<ul style="list-style-type: none"> Discusses what tests/procedures were used in an organized, clear, and concise manner. 	<ul style="list-style-type: none"> Discusses methods, but is disorganized, vague, or verbose, or uses lots of jargon. 	<ul style="list-style-type: none"> Contains no discussion of the method or procedure.
Results. The abstract has provided an explanation of what was discovered or produced using concise, and specific detail.	<ul style="list-style-type: none"> Refers and connects results to the methods and conclusions. Presents results independently of methods. Includes appropriate statistics or numerical analysis or results. Gives a justification if no data/results are possible. 	<ul style="list-style-type: none"> Merely states results [qualitatively]. If no results are possible, then only says "No results." 	<ul style="list-style-type: none"> Contains no results or doesn't even mention results.
Conclusion. The abstract interprets the results, evaluates what the results mean to the project, and defines the context within the field.	<ul style="list-style-type: none"> Logically connects results sited into a reasonable argument. Suggests further work (if applicable). Provides meaning and context to work. 	<ul style="list-style-type: none"> Either reflects the purpose or only suggests further research without providing context. 	<ul style="list-style-type: none"> Contains no conclusion.

EXAMPLE scored 10 points:

Introduction -2 pts.	<p>Acetone is a component in many inhalants that have been widely abused. While other solvents have addictive potential, such as toluene, it is unclear whether acetone alone contains addictive properties. The locomotor relative glucose metabolism and abusive effects of acetone inhalation were studied in animals using the conditioned place preference (CPP) paradigm and [¹⁸F]2-fluorodeoxy- D- glucose (¹⁸FDG) imaging. The CPP apparatus contains two distinct conditioning chambers and a middle adaptation chamber, each lined with photocells to monitor locomotor activity. Adolescent Sprague-Dawley rats (n=16; 90-110 g) were paired with acetone in least preferred conditioning chamber, determined on the pretest day. The animals were exposed to a 10,000 ppm dose for an hour, alternating days with air. A CPP test was conducted after the 3rd, 6th and 12th pairing. In these same animals, the relative glucose metabolism effects were determined using positron emission tomography (PET) imaging with ¹⁸FDG. Following the 3rd pairing, there was a significant aversion to the acetone paired chamber (190.9 ± 13.7 sec and 241.7 ± 16.9 sec, acetone and air, respectively). After the 6th pairing, there was no significant preference observed with equal time spent in each chamber (222 ± 21 sec and 207 ± 20 sec, acetone and air-paired, respectively). A similar trend was observed after the 12th pairing (213 ± 21 sec and 221 ± 22 sec, acetone and air-paired, respectively). Locomotor analysis indicated a significant decrease (p < 0.05) from air pairings to acetone pairings on the first and sixth pairings. The observed locomotor activity was characteristic of central nervous system (CNS) depressants, without showing clear abusive effects in this CPP model. In these studies, acetone vapors were not as reinforcing as other solvents, shown by overall lack of preference for the acetone paired side of the chamber. PET imaging indicated a regionally specific distribution of ¹⁸FDG uptake following acetone exposure. Further studies using different concentrations are required to better understand the locomotor and behavioral effects of acetone. This study confirms that the combination of microPET and the CPP paradigm can be used to elucidate the effects of abused solvents versus non-abused solvents in inhalants.</p>
Methods- 2 pts	
Results- 2 pts.	
Analysis- 2 pts	
Conclusion- 2pts	

Mechanics-2pts-
No obvious errors.

<u>Grading Rubric for Alternative Abstract</u>	<u>2</u> Fully meets all requirements and expectations	<u>1</u> Partially meets requirements	<u>0</u> Does not meet minimum requirements
Mechanics. The abstract contains proper spelling, grammar, complete sentences, syntax, diction, and is readable.	<ul style="list-style-type: none"> Contains no spelling, word usage, grammar, or mechanics mistakes. Defines all acronyms and abbreviations except the <i>very</i> common ones. 	<ul style="list-style-type: none"> Contains two or fewer mistakes in grammar, word usage, spelling, or mechanics. Contains one or more undefined acronyms, abbreviations or key term. 	<ul style="list-style-type: none"> Contains three or more mistakes and numerous undefined terms.
Introduction. The abstract briefly states the subject of investigation or project and its context.	<ul style="list-style-type: none"> Gives concise, thorough introduction to provide context and background of project. 	<ul style="list-style-type: none"> Either does not define key terms or uses them incorrectly. Either does not give enough information or provides unclear context or background 	<ul style="list-style-type: none"> Contains no introduction. Starts with either methods or results.
Reference Material Summary. The abstract identifies a summary of the resources used in the investigation that might include existing methods, models, programs, or literature.	<ul style="list-style-type: none"> Discusses previous or existing models, research or incarnations in an obvious, clear, and concise manner. 	<ul style="list-style-type: none"> Contains verbose, vague, or undefined jargon, but does mention other research. 	<ul style="list-style-type: none"> Does not provide references or references are inappropriate to project.
Comparison or Interpretation. The abstract has provided an explanation of what was accomplished and/or what compares to similar projects using concise, but specific detail.	<ul style="list-style-type: none"> Clearly, concisely (possibly qualitatively or quantitatively) compares work to prior research, models, or policy. 	<ul style="list-style-type: none"> Contains disorganized or unclear comparison or interpretation. States results with little or no comparison or interpretation. 	<ul style="list-style-type: none"> Merely summarizes work with no context or evaluation.
Discussion. The abstract evaluates the value and/or uniqueness of the work.	<ul style="list-style-type: none"> Clearly and concisely reflects back to purpose and/or results. Defines relevance and uniqueness to the field. Suggests of further work or applications (if possible). Provides meaning and context of work. 	<ul style="list-style-type: none"> Contains a discussion, but it may be either vague or verbose in reflection upon purpose, relevance, or future of work. 	<ul style="list-style-type: none"> Contains no discussion; merely states results.

Example (scored a 7):

Title: The Creation of a Process Flow Diagram and Mass Balance Sheet for the Remote Treatment Project.

Creation of a process flow diagram for the Remote Treatment Project is necessary to detail the functional and all other requirements of a facility for segregation and treatment of radioactive waste. Waste needing treatment is remote handled and as so the facility will need to be shielded for the protection of the workers. A process flow diagram and associated mass balance sheet provide essential information for justification of a proposed facility and related equipment. **Informational records on the waste that is stored at both Argonne National Laboratory and the Idaho National Engineering Laboratory is limited, thus limiting the accuracy of a mass balance sheet. In creating mass balance sheets for the waste many assumptions were made and great effort was taken to record how assumptions were made.** The process flow diagram and mass balance content are bases on the best available information. Taking into account the types of assumptions and the lack of hard facts about the waste contents the information collected is meant to only be used as rough estimates. **It is believed that the only way to definitively know the volumes and masses of waste streams is to open, segregate, and repackage all waste containers. Such is the primary objective of the proposed facility.**

Introduction-
2pts

Summary-
2pts

Interpretation-1pt-
unclear what student
"did" different from
current models

Discussion-
1pt- unclear
how his/her
work aids the
waste facility

Mechanics-1pt-
"based" instead of
bases